

are not followed, and the work is not what men of science desire to encourage. It is satisfactory to know that at least in a large number of our secondary schools the science periods are made the means of inculcating habits of careful observation, persistent verification, and truthful reasoning.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 23.—"On the Effects of Alkalies and Acids, and of Alkaline and Acid Salts, upon Growth and Cell Division in the Fertilised Eggs of *Echinus esculentus*.—A Study in Relationship to the Causation of Malignant Disease." By Prof. B. Moore, Dr. Herbert E. Roaf, and E. Whitley. Communicated by Prof. W. A. Herdman, F.R.S.

The attention of the authors was attracted to the study of the effects of small variations in reaction upon the growth of cells from the biochemical point of view, as a result of the observation that in malignant disease no hydrochloric acid is in general secreted by the gastric glands, no matter where the malignant growth is situated, which pointed to an increased alkalinity of the plasma.

In the course of investigations upon the rate of growth of the cell, when microscopic examination was made of the cells in the fresh condition, the authors were struck by the marked irregularities in size and shape of the developing cells in alkaline media, illustrated by cells in fresh solution developing in sea-water, to which di-sodium phosphate has been added, and also by marked tendencies to nuclear proliferation.

This led secondarily to a cytological investigation of the cells when fixed and stained to show nuclear division, as a result of which the authors have found the irregular forms of mitosis described in the paper. These atypical divisions, which have been produced by variations in the medium similar to those which occur in the blood in cases of malignant disease, closely resemble the pathological divisions seen in the growths of malignant disease.

The results of the experiments and their relationship to the processes in malignant growths may be summarised as follows:—

(1) In nearly all cases of malignant disease the secretion of hydrochloric acid by the gastric glands is stopped or greatly reduced, and this effect is not due to local conditions in the stomach, since it occurs wherever the growth is situated, but is due to a change in the distribution of salts in the plasma whereby the alkalinity is increased or the concentration in hydrogen ions diminished.

(2) Addition of small amounts of alkalies or alkaline salts, such as di-sodium phosphate, to the medium in which cells are growing and dividing causes at first an increase in rate of growth and division, but as the amount is increased there appears a marked tendency to irregularity in size and shape of the resulting cells. Nuclear division becomes in advance of cytoplasmic division, so that the cells become multi-nucleated. As the alkali is further increased, both cell division and nuclear division are stopped.

(3) Accompanying the increased stimulus to nuclear division given by the dilute alkali, there are seen many of the atypical forms of mitosis described in malignant growths. The variations from the normal illustrated in the drawings are:—(1) multiple nuclei in the same cell in active division; (2) multipolar mitosis, occurring both in the single cell stage, and later in the development of the organism; (3) asymmetrical mitosis, leading to unequal distribution of chromosomes to the two daughter cells; (4) reduction in length of the chromosomes as the strength of alkali is increased until the chromosomes appear as rounded dots, and accompanying the reduction in length there is also a reduction in number to about one-half the normal; (5) in certain cases the chromatin becomes arranged in circles, each of which shows a number of thickenings. The circles are arranged in groups in the cell, and appear to represent a stage in the anaphase, the groups being placed at about the usual distance apart of the centrosomes, and traces of the achromatic fibres being occasionally visible.

"On certain Physical and Chemical Properties of Solutions of Chloroform and other Anæsthetics.—A Contribution to the Chemistry of Anæsthesia. (Second Communication.)" By Prof. B. Moore and Dr. Herbert E. Roaf. Communicated by Prof. C. S. Sherrington, F.R.S.

The experiments recorded in the present communication support the conclusion drawn in a previous paper by the authors that anæsthetics form unstable compounds or aggregates with the proteids of the tissue cells, and that anæsthesia is due to a paralysis of the chemical activities of the protoplasm as a result of the formation of such aggregations.

The comparative experiments with ethereal extracts demonstrate that the action is upon the cell proteids and not upon the lipoids.

The compounds or aggregations so formed are unstable, and remained formed only so long as the pressure of the anæsthetic in the blood is maintained.

The results of the experiments may be summarised as follows:—

(1) The solubility of all anæsthetics experimented with is higher in serum than in water.

(2) At a certain concentration, definite for each anæsthetic, there occur opalescence and commencing precipitation of proteid.

(3) At equal concentration of chloroform in water or saline on the one hand, and serum, hæmoglobin, or the tissues (brain, heart, muscle, and liver) on the other, the vapour-pressure is always higher in the former than in the latter.

(4) The curve connecting vapour-pressure and concentration is, in the case of water and saline, a straight line; while in the case of serum, hæmoglobin, and the tissue proteids it is a curve showing association, especially at the higher concentrations.

(5) Comparative determinations of vapour-pressure and concentration, in serum and brain tissue and in ethereal extracts of these equal in concentration of lipoid, show that the proteid of the tissue combines with the anæsthetic.

(6) Determinations of the effects of addition of chloroform upon the lowering of freezing point confirm the results obtained by the vapour-pressure and solubility determinations.

(7) Determinations of the changes in electrical conductivity caused by addition of chloroform indicate that accompanying the combination of the anæsthetic with the proteid there takes place a splitting off of electrolytes.

(8) When the lipoids, extracted from serum or tissues by ether, are made up into an emulsion with normal saline, many of the lipoids take the form of bi-concave discs.

(9) The lipoid emulsions are very permanent, but separate on the addition of anæsthetics or neutral salts, in similar fashion to colloidal solutions.

"A Note on the Effect of Acid, Alkali, and certain Indicators in Arresting or otherwise Influencing the Development of the Eggs of *Pleuronectes platessa* and *Echinus esculentus*." By E. Whitley. Communicated by Prof. W. A. Herdman, F.R.S.

(1) The amount of variation from the normal concentration of hydrogen and hydroxyl ions in sea-water which the eggs of *Pleuronectes* will tolerate is very small.

(2) A disturbance of the equilibrium towards the acid side is much more fatal than the opposite.

(3) A progressive development of resistance to an unfavourable action of the environment takes place in proportion to the age of the eggs.

(4) Phenolphthalein is deadly to the eggs of *Echinus esculentus*, but harmless to those of *Pleuronectes*, while dimethyl quickly kills the latter, and appears, if anything, to have a favourable influence upon the development of the former.

Anthropological Institute, December 5.—Prof. W. Gowland, president, in the chair.—A Dyak witch doctor's medicine chest: R. Shelford. The chest is cylindrical in shape and about a foot high, and contains various charms, including water-worn pebbles, a crystal, used for a kind of crystal gazing, and a few simples which have actual curative properties.—Ruins in Rhodesia: D. Randall

MacIver. Mr. MacIver visited sites at Inyanga, Niekirk, N'Natali, Umtali, Dhlo-Dhlo, Kami, and Zimbabwe, views of all of which were shown. At Inyanga there are countless "pit dwellings," consisting of a pit and passage and hut platforms. The elucidation of the mystery of their use is assisted by a study of the Niekirk ruins, which are the most remarkable in the country. The area of these ruins is not less than fifty square miles, and within this area it is almost impossible to walk more than ten yards without coming upon a wall. The general principle appears to be that each hill constitutes a separate unit complete with its own buildings and divided at the bottom from its neighbour by a boundary wall, which is the first of a series of concentric lines. These lines cannot have been for purposes of irrigation, but must have been entrenchments. They always cease at the crown of the hill, which is covered by a series of buildings, and it is this fact which shows the bearing of these walls in the problem of the pit dwellings. The buildings in the hill are of two types, one divided by successive stages from the pit dwelling and the other the pit dwelling itself. The forts at Niekirk are also generally of similar or derived form to those at Inyanga. Similarly, the more advanced type of buildings found at Umtali or elsewhere are all derivatives of the pit dwelling, and Great Zimbabwe itself falls into line, and was simply a royal kraal. In the whole country there seems to be a regular progression with regard to these buildings, the northern region being the most fortified, and the defensive scheme becoming less rigorous towards the south. As to the buildings of these forts and dwellings, all the implements found are of the type used by the natives of the present day, and as at Niekirk there is no evidence of modern squatting it seems fair to presume that similar implements found elsewhere are also not the results of squatting, but were left by the original builders. As to the date, Mr. MacIver cut sections in the ruins he visited, and at Dhlo-Dhlo he made a most significant and conclusive discovery. A trench was cut below the intact cement floor of a hut, and amongst other objects Mr. MacIver discovered fragments of Nankin china. Consequently, no stone was laid at Dhlo-Dhlo before the time when Nankin china was manufactured and imported from the East; experts fix this date as the sixteenth century A.D. This find conclusively fixes the date, for Dhlo-Dhlo and all the other remains exhibit similar characteristics of building, and it may be taken as proved that the ruins of Rhodesia are mediæval or post-mediæval, that they cannot be possibly placed earlier than the eleventh century (probably the very oldest building was not erected before the fourteenth century), and that they were built by a native African race not differing to any great degree from the modern natives.

Entomological Society, December 6.—Mr. F. Merrifield, president, in the chair.—*Exhibitions.*—A series of varieties of the Mediterranean *Carabus morbillosus*, showing all intergradations from the ordinary *morbillosus*, and presenting a striking case of geographical variability: Dr. K. Jordan.—Specimens of *Ptinus pusillus*, Stwem., recently discovered in a corn factor's shop at Edmonton: H. St. J. Donisthorpe.—A hermaphrodite of the Proctotrupidæ, a sand-wasp without wings captured by Mr. Poole, and the ♂ *Apion semivittatum*, Gyll., taken many years ago by Mr. Walton near the Tivoli Gardens, Margate, together with a ♀ specimen of the same species discovered while sweeping long grass near the Chequers Inn, Deal, on September 26, 1904: A. J. Chitty.—A ♂ and ♀ example of the Dipteron *Helophilus transfusus*, L., taken from thistle-heads in the fen marshes at Edmonton last July, and a specimen of *Stenopteryx hirundinis*, a parasite on swallows and martins found on Box Hill, Surrey, in August: F. B. Jennings.—Specimens of *Odontoptera bidentata* ab. *nigra*, the melanic form of which is rapidly increasing in the Wakefield district of south Yorkshire: G. T. Porritt.—Specimens of South African Pierine butterflies taken in the dry season this year, further illustrating the diverse forms, and with them, for comparison, specimens taken during the rains: Dr. F. A. Dickey.—A ♂ and ♀ specimen of *Ornithoptera chimaera*, Rothschild, and some remarkable species of *Delias* collected recently by Mr. A. S. Meek in the mountain region of

British New Guinea: O. E. Janson.—Specimen of a Buprestid beetle, *Cyria imperialis*, Don., having, in addition to the normal fore-leg on the left side, two supplementary fore-legs originating from separate coxæ: Commander J. J. Walker, on behalf of Mr. A. M. Lea.—♂ and ♀ examples of *Tryptopium crawshayi*, Sharp, bred by the Rev. G. A. Crawshaw from eggs deposited in July last in the bark of larches at Leighton Buzzard: G. C. Champion.—Unique specimen of *Depressaria emeritella*, Stn., from an unknown locality, on which the species was added to the British list many years ago, and a specimen of *Cerostoma asperella*, L., discovered by Mrs. Hutchinson near Leominster on September 21, 1881, and only taken, as regards Britain, in Dorset (formerly), and Herefordshire very rarely: E. R. Bankes.—Series of *Tryphaena comes* bred through three generations, and brought together to test the relative proportions of melanic to non-melanic forms and the possible range of variations to be obtained from a single pair of parents: A. Bacot. The exhibitor announced that all the results of the second and third generations seemed to be capable of "Mendelian" explanation.—(1) Larvæ of *Collyris emarginatus*, Dej., from Borneo, observed with mouth-parts qualified to excavate burrows in wood. (2) Larvæ and pupæ of *Mormolyce*, together with a specimen of a fungus of *Polyporus* split open to show the lenticular chamber excavated by the larva, to which access was obtained by so small an orifice that it was surprising that the emerged beetle could squeeze through: R. Shelford.—*Papers.*—Some observations by Mr. A. H. Hamm, of the Hope department, Oxford University Museum, tending to confirm the opinion that *Pieris rapæ* chooses for prolonged rest a surface on which it will be concealed: E. B. Poulton.—On the emergence of *Myrmeleon formicarius*: W. J. Lucas.—Descriptions of new species of African Halcinæ and Galerucinæ: M. Jacoby.—On the ichneumonoid group *Tryphonides schizodonti*, Holmgr., with descriptions of new species: C. Morley.

Linnean Society, December 7.—Prof. W. A. Herdman, F.R.S., president, in the chair.—On the ætiology of leprosy: Dr. J. Hutchinson, F.R.S. The author adduced much evidence from all parts of the world in support of the fish hypothesis of the cause of leprosy, more especially from South Africa, China, and Norway. In places where the disease is scattered and infrequent there might, he admitted, be some difficulty in tracing the association of cause and effect; but if regard be taken of those only in which excessive prevalence occurs, all hesitancy would disappear. He challenged anyone, not yet convinced, to name any place in the whole world in which the leprosy prevalence exceeded 50 per 10,000 which was not either a fishing-station or notorious for the consumption of bad fish. As instances of places where this enormous prevalence has been recorded, the following were mentioned:—Minicoy (Maldives), Kalagoan (Bengal coast), Fiji, and the Sandwich Islands. By way of affording a standard of comparison, it was added that the prevalence in Ceylon was only 2 per 10,000, and in India as a whole less than 6.

Faraday Society, December 12.—Mr. James Swinburne, vice-president, in the chair.—The physics of ore flotation: J. Swinburne and Dr. G. Rudolf. The flotation of ores to separate them from gangue is carried out by treating them with dilute acid, or acid sodium sulphate, at a temperature short of boiling water. Little bells of CO₂ attach themselves to the ore particles, but not to the gangue, and the ore particles are floated to the surface, where they are skimmed off. The questions are why the sulphides are selected, and why the temperature matters. The authors hold that it is a question of two opposing forces—adhesion between the solids and the liquid which varies with different solids and liquids, and surface tension of the liquid.—The concentration of metalliferous sulphides by flotation: Prof. A. K. Huntington. The paper also embodies the author's contribution to the discussion on the previous paper. Experiments are described which prove that the gas causing flotation is CO₂ derived from native carbonates of iron and manganese present in the ore, and not from calcite or from carbonates produced on the surface of the sulphides by weathering. Carbonates which are decomposed by dilute sulphuric acid in the cold do not

give rise to the formation of a scum. Experiments are also described showing that the gas escaping during flotation carries an electrical charge, leaving an opposite charge on the solution. The assumption of Messrs. Swinburne and Rudolf of the presence of an air-film on the surface of the sulphide particles is criticised, and it is shown that the particles are floated perfectly after precautions have been taken to remove any adherent film of gas by exhaustion with acid, washing with alcohol, treatment with air-free distilled water, and exhaustion with the pump.—The ions of pure water: Prof. J. Walker. In the discussion on Dr. Lowry's paper on an application to electrolytes of the hydrate theory of solution, Mr. Bousfield directed attention to an apparent discrepancy between the temperature coefficient of the mobility of hydrogen and hydroxide ions on the one hand, and the temperature coefficient of the conductivity of water on the other. The author points out that when the data obtained by Kohlrausch for pure water are employed, and when allowance is made for the temperature coefficient of ionisation, the discrepancy vanishes.

Geological Society, December 12.—Dr. J. E. Marr, F.R.S., president, in the chair.—The physical history of the great Pleistocene lake of Portugal: Prof. E. Hull. There is evidence that the general level of the lake-bed was once nearly that of the outer sea, and that the sea-waters gained occasional access to the lake during the earlier stage of its formation. The lake was eventually drained by the channel cut by the Tagus at the harbour of Lisbon, upon the elevation of the land to about its present level.—The geological structure of the Sgùrr of Eigg: Dr. A. Harker. The conclusions arrived at bring the rock of the Sgùrr of Eigg into relation with the other British Tertiary pitchstones, which are all intrusive.

MANCHESTER.

Literary and Philosophical Society, November 28.—Sir W. H. Bailey, president, in the chair.—Experiments on the variation of the electrical resistance of osmium with the temperature: H. Morris-Airey. The range over which the experiments were conducted extended from the temperature of liquid air up to dull red heat. The results show that the behaviour of osmium, like that of the ordinary metals, can be represented by a parabolic expression.

DUBLIN.

Royal Dublin Society, November 21.—Prof. W. F. Barrett, F.R.S., in the chair.—Energy of secondary radiation: Prof. J. A. McClelland. This paper is a continuation of previous papers in which the author studied the secondary radiation of β particles that is emitted by substances when acted upon by the β rays of radium. The relative intensity of the secondary radiation from a large number of elements for the same incident radiation has been previously measured, the results showing that the secondary radiation is always greater the greater the atomic weight. In the present paper the total energy of the secondary radiation from a lead plate is compared with the energy of the primary radiation that produces it, the plate being thick enough to prevent the transmission of any radiation; the ratio is found to be 0.62 for lead, and corresponding numbers are given for other elements, the numbers, of course, diminishing with decreasing atomic weight, the number for carbon being 0.19. From the known value of this ratio we can calculate theoretically what percentage of the energy absorbed by any element of the plate is set free again as secondary radiation; the percentage is as high as 94 for lead and 95 for uranium, with smaller values for lower atomic weights, the percentage for carbon being 53. The importance of this large transformation of the energy of the primary radiation into secondary radiation is shown by some examples. The relation between the coefficient of absorption of the β rays and the value it would have if there were no secondary radiation is calculated; for lead one coefficient is about four times the other. Again, when we determine the coefficient of absorption of a radiation by measuring the intensity

after passing through successive layers of a substance, we should, on account of secondary effects, get values of the coefficient diminishing with increased thickness traversed, even if the radiation were perfectly homogeneous. For this reason the β rays from radium are not so heterogeneous as they appear to be from observations on absorption. The paper shows how to determine the true coefficient from such observations.—An improved form of entoptoscope for the detection and delineation of cataract, &c.: W. F. Barrett, F.R.S. The author exhibited this instrument, and fully described it with the aid of diagrams and lantern slides.

Royal Irish Academy, November 30.—Prof. R. Atkinson, president, in the chair.—Second report on Irish cave explorations: Dr. R. F. Scharff, chairman of the committee. Dr. Scharff gave a general survey of the investigation, and mentioned that the report embodied the results of the work carried on in the caves of co. Clare during the years 1903-4 under the direction of Mr. R. J. Ussher. The latter subsequently showed a series of lantern slides giving a narrative of the events. Prof. Cole described the geological features. The caves originated by the solvent action of water on the Carboniferous limestone, and may possibly be pre-Glacial. Mr. Westropp read the portion of the report dealing with the tools and ornaments found, which included chert scrapers, various bone implements, bronze pins, and a beautifully worked bronze buckle, as well as an ancient gold bracelet. Prof. A. F. Dixon dealt with the human remains, while Mr. Newton described the very numerous bird bones, which included those of the crane, now only an extremely rare irregular visitor to the British Isles. The mammalian and other vertebrate and invertebrate animal remains had been determined by Dr. Scharff, who exhibited specimens of the bones and teeth of Irish elk, reindeer, Arctic lemming, Arctic fox, bear, wolf, and Caffer cat, and those of domestic animals, &c., making remarks on their horizontal, vertical, &c., distribution in the caves.—On the former occurrence of the African wild cat (*Felis ocreata*, Gmel.) in Ireland: Dr. R. F. Scharff. Remains of the wild cat are abundant in the upper stratum of the Clare caves. Careful measurements show that this cat was not the wild cat of Europe (*Felis catus*), but the African cat (*F. ocreata*=*F. maniculata*), and that the English cave remains of cat are also mostly referable to the latter species.

EDINBURGH.

Royal Society, November 20.—Lord McLaren, vice-president, in the chair.—Some further results obtained with the spectroheliometer: Dr. J. Halm. This was a sequel to a previous communication already published in which the main object was to find how Carrington's law of solar rotation varied with the sun-spot cycle. The relative shift of certain solar spectrum lines taken from opposite limbs of the sun was determined by comparing their positions with the positions of neighbouring telluric lines. If, however, instead of the difference of the positions of a chosen solar line the mean be taken, the true position of the solar line referred to the neighbouring telluric line is obtained as it would be were the sun not subject to rotation. Now, according to Doppler's principle, the relative position of the solar and telluric lines so determined should be affected by (1) the annual motion of the earth as it recedes from and approaches to the sun; (2) the diurnal motion of the earth on its axis; and (3) the swing of the earth about the centre of gravity of the earth and moon during one complete lunation. The amounts of the displacements of the lines in the solar spectrum due to these three motions may be calculated. The monthly motion is too small to be detected with certainty, being of the same order as the errors of observation. The instrument was capable of detecting the others. By calculating the diurnal effect and subtracting it from the observed positions, Dr. Halm obtained a distinct annual periodicity in the measured positions of the chosen line, and the observed variation agreed within the errors of observation with the calculated effect. Similarly, subtraction of the calculated annual effect left the diurnal effect clearly marked

and agreeing also remarkably well with the calculated value. In the observations, however, which had extended over the last four years, there existed undoubted evidence of a shift which could not be explained in terms of any known motions. It would be interesting to see how this shift continued as the sun-spot cycle passed through its approaching maximum. The only suggestion which the author had to offer in explanation was the possible effect of a changing pressure in the sun in the neighbourhood of the material giving the line.—Observations on the normal temperature of the monkey and its diurnal variation, and on the effect of changes in the daily routine on this variation: Drs. Sutherland **Simpson** and J. J. **Galbraith**. The diurnal temperature variation in the monkey had considerable range, being about twice that of man in normal health. The temperature reached its maximum during the day and its minimum at night. When by artificial illumination and darkening of the room day and night were interchanged, and when at the same time the meals were altered appropriately, the temperature variation was found to change also, the maximum always coming during the time of activity. Starvation for three days quite did away with the rhythmic character of the variation.—Notes on the effect of electric oscillations (co-directional and transverse) on the magnetic properties of iron: J. **Russell**. The oscillations were obtained from an induction coil, and their general effect was greatly to increase the induction in moderate fields, and also to increase the hysteresis during a complete cycle. When the cycles were compared between the same limits of induction, the effect of the electric oscillations was to diminish the hysteresis.—Some electrical measurements on metals: Dr. C. E. **Fawsitt**. The aim of the experiments was to measure the electromotive position of two specimens of the same metal, one of which had been rapidly cooled and hardened and the other slowly cooled and annealed. The metals used were silver, gold, and platinum, and in all cases the hardened amorphous form was found to be electropositive to the annealed crystalline form when placed in dilute acid, the potential difference being about 0.013 volt.

NEW SOUTH WALES.

Linnean Society, September 27.—Mr. T. Steel, president, in the chair.—Notes from the Botanic Gardens, Sydney, No. 11: J. H. **Maiden** and E. **Betche**. In addition to several new species and varieties described, the following species are recorded as new for New South Wales:—*Capparis sarmentosa*, A. Cunn., from the Macpherson Range; *Casearia esculenta*, Roxb., from the same locality (the discovery of this species adds another order, Samydcaceæ, to the flora of New South Wales); *Pultenaea mollis*, Lindl., from Gilgandra; *Erythroxylon australe*, F.v.M., from the Macpherson Range; *Strychnos psilosperma*, F.v.M., from the same locality; *Marsilea angustifolia*, R.Br., from Gilgunnia.—Notes on the native flora of New South Wales, part iv., the occurrence of *Casuarina stricta*, Ait., on the Narrabeen shales: R. H. **Cabbage**. *Casuarina stricta* is one of the sheoaks found chiefly in the southern part of Australia, including Tasmania, and it is also common in the interior of New South Wales. The author recently found it growing on the Narrabeen shale formation at Newport. The shales dip southerly from Narrabeen, and pass under Port Jackson at a depth of nearly 1000 feet, but outcrop again at Otford and Stanwell Park, where *C. stricta* also reappears. The theory is advanced that in late or post-Tertiary time this species flourished on what is now regarded by geologists as the submerged continental shelf, but formerly was a continuation of the present land-surface, extending, perhaps, twenty miles easterly to the 100-fathom line. As the Narrabeen shales in the vicinity of Port Jackson also rise to the eastward, they would probably have formed the surface in places beyond the present shore-line, and it is suggested that *C. stricta* worked its way up from the south, partly along this old land-surface, but, owing to the subsidence, has all been destroyed with the exception of these isolated remnants at Newport, Otford, and Jervis Bay.—Census Muscorum Australiensium: a classified catalogue of the frondose mosses of Australia and Tasmania,

collated from available publications and herbaria records: part ii.: Rev. W. W. **Watts** and T. **Whitelegge**. This second part of the census completes the mosses known as acrocarps. About 370 species are listed.

October 25.—Mr. T. Steel, president, in the chair.—The geology of the New Hebrides: D. **Mawson**. The following is a summary of the author's conclusions:—The chain of islands forming the New Hebrides group owes its existence primarily to the development during Miocene times of a fold-ridge apparently continuous with that passing around the north of New Guinea through Sumatra and on to the better known region of the Himalayas and southern Europe. In the New Hebrides the folding period was preceded by local shallow marine conditions and subdued volcanic activity. The folding force would appear to have been exerted from the direction of Fiji against the foreland of New Caledonian crystalline schists and gneisses; a single ridge probably resulted defining the western line of islands where extensive outcrops of Miocene strata are exposed—in Santo, Malekula, and possibly Efate.

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